CLAIMS

What is claimed is:

1. A method for optically analyzing blood vessel walls, the method comprising:
   receiving optical signals from the vessel walls;
   resolving a spectrum of the optical signals to generate spectral data;
   transforming the spectral data into dual-domain spectral data;
   using the dual-domain spectral data to analyze the vessel walls.

2. A method as claimed in claim 1, wherein the step of transforming the spectral data into dual-domain spectral data comprises applying a wavelet prism.

3. A method as claimed in claim 1, wherein the step of transforming the spectral data into the dual-domain spectral data comprises applying a time-frequency transform and decomposition methods, optimized in response to analytes and interferants.

4. A method as claimed in claim 1, further comprising illuminating the blood vessel walls with an optical source.

5. A method as claimed in claim 4, wherein the optical source generates near infrared light.

6. A method as claimed in claim 1, wherein the step of receiving the optical signals comprises detecting returning radiation to a catheter head.

7. A method as claimed in claim 1, wherein the step of using the dual-domain spectral data to analyze the vessel walls comprises determining whether the blood vessel walls are comprised of vulnerable or non-vulnerable plaques.

8. A method as claimed in claim 1, wherein the step of using the dual-domain spectral data to analyze the vessel walls comprises measuring vulnerability for a risk of heart attack.

9. A method as claimed in claim 1, wherein the step of transforming the spectral data into dual-domain spectral data is performed as a preprocessing step.

10. A method as claimed in claim 1, wherein the step of transforming the spectral data into dual-domain spectral data is performed as a preprocessing step, before application of multivariate regression techniques.

11. A method as claimed in claim 1, wherein the step of transforming the spectral data into dual-domain spectral data is performed as a preprocessing step, before application of a discrimination model.

12. A method as claimed in claim 11, wherein the discrimination model is a single domain model.

13. A method as claimed in claim 11, wherein the discrimination model is a dual domain model.

14. A method as claimed in claim 1, wherein the step of transforming the spectral data into dual-domain spectral data is performed as a preprocessing step that includes removing low-frequency components of the dual-domain spectral data to reduce noise.

15. A method as claimed in claim 1, further comprising preprocessing the spectral data before transforming the spectral data into the dual domain spectral data.

16. A method as claimed in claim 1, wherein the step of using the dual-domain spectral data to analyze the vessel walls comprises applying dual domain multivariate regression techniques.

17. A method as claimed in claim 16, wherein the step of using the dual-domain multivariate regression techniques to analyze the vessel walls comprises applying weight strategy.

18. A method as claimed in claim 17, wherein the step of applying the weight strategy comprises applying cross-validation techniques.

19. A method as claimed in claim 17, wherein the step of applying the weight strategy comprises applying a receiver operating characteristic - area under curve analysis.

20. A method as claimed in claim 1, wherein the step of using the dual-domain spectral data to analyze the vessel walls comprises applying multivariate regression discrimination techniques.

21. A method as claimed in claim 20, wherein the step of using the dual-domain multivariate discrimination techniques to analyze the vessel walls comprises applying a weight strategy.

22. A method as claimed in claim 21, wherein the step of applying the weight strategy comprises applying cross-validation techniques.

23. A method as claimed in claim 21, wherein the step of applying the weight strategy comprises applying the receiver operating characteristic - area under curve analysis.

24. A method as claimed in claim 21, wherein the step of applying the weight strategy comprises applying optimization to maximize separation between discrimination classes and to increase the prediction performance of vulnerability for a risk of heart attack.

25. A method as claimed in claim 20, wherein the step of using the dual-domain multivariate discrimination techniques to analyze the vessel walls comprises applying a receiver operating characteristic - area under curve analysis technique to set a decision boundary.

26. A method as claimed in claim 1, wherein the step of using the dual-domain spectral data to analyze the vessel walls comprises applying a Mahalanobis classifier.

27. A method as claimed in claim 26, wherein the step of applying the dual-domain Mahalanobis classifier comprises applying a receiver operating characteristic - area under curve analysis technique to set decision boundary (surface) in high-dimension space.

28. A system for optically analyzing blood vessel walls, the system comprising:
a detector system for receiving optical signals from the vessel walls;
a spectrometer for resolving a spectrum of the optical signals in wavelength to generate spectral data;
an analyzer for transforming the spectral data into dual-domain spectral data and using the dual-domain spectral data to analyze the vessel walls.

29. A system as claimed in claim 28, wherein the analyzer transforms the spectral data into dual-domain spectral data using a wavelet prism.

30. A system as claimed in claim 28, wherein the analyzer applies a time-frequency transform and decomposition methods, optimized in response to analytes and interferants.

31. A system as claimed in claim 28, further comprising an optical source for illuminating the blood vessel walls.

32. A system as claimed in claim 31, wherein the optical source generates near infrared light.

33. A system as claimed in claim 28, further comprising a catheter head for receiving the optical signals.

34. A system as claimed in claim 28, wherein the analyzer determines whether the blood vessel walls are comprised of vulnerable or non-vulnerable plaques.

35. A system as claimed in claim 28, wherein the analyzer measures a vulnerability for a risk of heart attack.

36. A system as claimed in claim 28, wherein the analyzer transforms the spectral data into dual-domain spectral data to preprocess the spectral data.

37. A system as claimed in claim 28, wherein the analyzer transforms the spectral data into dual-domain spectral data, before applying of multivariate regression techniques.

38. A system as claimed in claim 28, wherein the analyzer transforms the spectral data into dual-domain spectral data, before applying a discrimination model.

39. A system as claimed in claim 38, wherein the discrimination model is a single domain model.

40. A system as claimed in claim 38, wherein the discrimination model is a dual domain model.

41. A system as claimed in claim 28, wherein the analyzer transforms the spectral data into dual-domain spectral data to preprocess the spectral data by removing low-frequency components of the dual-domain spectral data to reduce noise.

42. A system as claimed in claim 28, wherein the analyzer preprocesses the spectral data before transforming the spectral data into the dual domain spectral data.

43. A system as claimed in claim 28, wherein the analyzer applies multivariate regression techniques.

44. A system as claimed in claim 43, wherein the analyzer applies a weight strategy.

45. A system as claimed in claim 44, wherein the application of the weight strategy comprises applying cross-validation techniques.

46. A system as claimed in claim 44, wherein the application of the weight strategy comprises applying a receiver operating characteristic - area under curve analysis.

47. A system as claimed in claim 28, wherein the analyzer applies multivariate regression discrimination techniques.

48. A system as claimed in claim 47, wherein the analyzer applies a weight strategy.

49. A system as claimed in claim 48, wherein the application of the weight strategy comprises applying cross-validation techniques.

50. A system as claimed in claim 48, wherein the application of the weight strategy comprises applying the receiver operating characteristic - area under curve analysis.

51. A system as claimed in claim 47, wherein the analyzer applies a receiver operating characteristic - area under curve analysis technique to set a decision boundary.

52. A system as claimed in claim 28, wherein the analyzer applies Mahalanobis classifier to the dual-domain spectral data to analyze the vessel walls.

53. A system as claimed in claim 52, wherein the analyzer applies a receiver operating characteristic - area under curve analysis technique to set decision boundary (surface) in high-dimension space.